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Monitoring, Implicit Contracting, and the Lack of Permanence of Leveraged Buyouts

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Abstract. We present a possible explanation for the lack of permanence of the very high levels of concentration of ownership that accompany leveraged buyouts. We first argue that some diffusion of ownership can be beneficial to the shareholders of a firm by encouraging the employees of the firm to enter into implicit contracts with the firm. The level of concentration of ownership that maximizes firm value is therefore that which trades off the well-known gains from monitoring with the gains from implicit contracting. We then argue that, in the process of concentrating the ownership of a firm that has excessively diffuse ownership to a level that maximizes firm value, investors in leveraged buyouts will choose an initial level of concentration of ownership that is very high. They will do so in order to put pressure on managers to breach existing implicit contracts. Following the breach of these contracts, investors will decrease the level of concentration of ownership to the level that maximizes firm value. There will be no further breach of implicit contracts, for such breach is incidental to the transformation of the firm from one that has excessively diffuse ownership to one that has the optimal level of diffusion of ownership. No change in the concentration of ownership therefore occurs once the level of diffusion of ownership that maximizes firm value has been attained.

Key words: Monitoring; Implicit contracting; Leveraged buyouts.

JEL Classification: G30.

This paper is motivated by the seemingly paradoxical observation that the very high levels of concentration of ownership observed at the outset of leveraged buyouts make possible very sizeable gains in efficiency (Kaplan, 1991; Lichtenberg and Siegel, 1990; Muscarella and Vetsuypens, 1990; Palepu, 1990; Smith, 1990), yet are not permanent (Kaplan, 1991), Van De Gucht and Moore, 1995). Although reverse leveraged buyouts maintain a higher level of concentration of ownership than that prevailing prior to the buyout (Dial, 1994; Kaplan, 1991; Holthausen and Larcker,

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1996), the decrease in the concentration of ownership is accompanied by a decrease in performance (Degeorge and Zeckhauser, 1993; Dial, 1994; Holthausen and Larcker, 1996) that makes the decision to decrease the concentration of ownership rather surprising.

The lack of permanence of very highly concentrated ownership suggests that there are costs as well as benefits to concentrated ownership. There are, equivalently, benefits as well as costs to diffuse ownership. The latter are well known, and are a consequence of the free-rider problem associated with diffuse ownership. In a widely-held firm, a shareholder who would seek to monitor managers would bear the entirety of the costs of doing so, but would have to share the benefits of her monitoring with the other shareholders of the firm. Her incentives to engage in monitoring are consequently much lower than if she were the unique shareholder of a closely-held firm, bearing all the costs and reaping all the benefits of her monitoring.

The first part of this paper argues that the benefits of diffuse ownership are also a consequence of the free-rider problem. The free-rider problem not only serves to deter shareholders from monitoring managers, but also serves to deter them from putting pressure on managers to renege upon the promises of deferred compensation made to employees.[1] When the effort that is to be exerted by employees and the compensation they are to be paid by managers acting on behalf of shareholders are noncontractible, effort and compensation must be part of an implicit contract, that, by its very nature, cannot be enforced by courts. Such a contract is therefore vulnerable to opportunism by either party, but especially by shareholders who have every incentive to have managers renege upon their promise of compensation once employees have exerted the non-contractible effort sought by shareholders. Employees will therefore be reluctant to enter into implicit contracts, leaving both parties worse off than if shareholders were able to commit not to put pressure on managers to breach existing implicit contracts. Diffuse ownership constitutes one such commitment mechanism, as a shareholder who would seek to put pressure on managers would bear the entirety of the cost of doing so, but would have to share the benefits of breach with the other shareholders of the firm.

The benefits of diffuse ownership suggest that the maximization of firm value requires some diffusion of ownership. They therefore provide an explanation for the lack of permanence of the very high levels of concentration of ownership observed at the outset of leveraged buyouts, but fail to explain the initial choice of such levels. The second part of this paper argues that, in the process of concentrating the ownership of a firm that has excessively diffuse ownership to a level that maximizes firm value, investors in leveraged buyouts will choose an initial level of concentration of ownership that is very high. They will do so in order to put

[1] Diffuse ownership also serves to deter shareholders from reneging upon promises of deferred compensation made to managers. As such reneging appears to be rare in leveraged buyouts, if only because managers are part of the buyout team (Jensen, 1993), our discussion considers only the promises of deferred compensation made to employees.

pressure on managers to breach existing implicit contracts.[2] Following the breach of these contracts, investors will decrease the level of concentration of ownership to the level that maximizes firm value. There will be no further breach of implicit contracts, for such breach is incidental to the transformation of the firm from one that has excessively diffuse ownership to one that has the optimal level of diffusion of ownership. No change in the concentration of ownership therefore occurs once the level of diffusion of ownership that maximizes firm value has been attained.

The paper thus considers a trade-off between efficiency and the breach of existing implicit contracts on the one hand and implicit contracting on the other, and argues that the changing terms of this trade-off in the case of a firm that has excessively diffuse initial ownership provide an explanation for the observed variation in the level of concentration of ownership. The flexibility investors are afforded to alter over time the concentration of ownership allows them to profit by having the manager breach existing implicit contracts, yet enter into new implicit contracts. It is beneficial ex-post, following the initial choice of effort by employees. It can, however, be costly ex-ante, as employees who foresee the breach of implicit contracts decrease the level of non-contractible effort they exert, thus decreasing firm value. This suggests that the flexibility to alter over time the concentration of ownership may reduce firm value.[3]

There have of course been other explanations for the lack of permanence of leveraged buyouts. These are the desire of investors in a leveraged buyout for liquidity and diversification (Palepu, 1990), and the role of leverage in constraining influence activities prior to divestures (Simon Bagwell and Zechner, 1993). These explanations share with the one presented in the present paper the existence of a trade-off that determines an optimal level of diffusion of ownership, and the requirement that the terms of this trade-off should change over time. They are examined in turn.

The desire for liquidity and diversification undoubtedly constitutes part of the explanation for reverse leveraged buyouts. It is not clear, however, why liquidity and diversification should not also be desired upon the acquisition of a firm, in which case very high concentrations of ownership would not be observed upon buyout. Only if the gains in efficiency obtained under very highly concentrated ownership were somehow permanent, altering the terms of the trade-off between efficiency on the one-hand and liquidity and diversification on the other, would investors initially choose very highly concentrated ownership, and then decrease the concentration of ownership. The work of Degeorge and Zeckhauser (1993), Dial (1994), and Holthausen and Larcker (1996) suggests that this is not entirely

[2] Managers are also encouraged to breach implicit contracts by the sizeable shareholdings they acquire in the course of leveraged buyouts.

[3] The preceding explanation has omitted leverage, a surprising omission perhaps for a paper that pertains to leveraged buyouts. This paper omits leverage because, although it does not deny the disciplining role of high leverage (Jensen, 1986), it views high leverage primarily as serving to make concentrated ownership possible, by reducing the extent of equity financing.

the case, as efficiency decreases following a decrease in the concentration of ownership. Further evidence in support of the relatively lesser importance of the desire for liquidity and diversification is provided by Kaplan (1991) and Van De Gucht and Moore (1995). Kaplan (1991) finds that larger leveraged buyouts are only moderately more likely to revert to public ownership, a finding that suggests 'a correspondingly moderate role for risk-bearing considerations'. Van De Gucht and Moore (1995) find that the probability of reversal is unrelated to size.

Simon Bagwell and Zechner (1993) view high leverage, such as characterizes leveraged buyouts, as serving to constrain influence activities prior to divesture decisions. An explanation of the lack of permanence of leveraged buyouts based upon this view therefore suggests that leveraged buyouts should be primarily intended to make large divestures possible, and that reverse leveraged buyouts should be observed once these divestures have been carried out. Such an explanation is strongly supported by the work of Bhagat, Shleifer, and Vishny (1990), whose empirical findings suggest that '[c]ontrol by raiders or by MBO teams is often a transitory arrangement used to allocate assets to corporations managing other similar assets'. It is perhaps less strongly supported by the work of Kaplan (1991), whose specific study of reverse leveraged buyouts suggests that '[t]he moderate fraction of LBO assets owned by other companies implies that asset sales play a role, but are not the primary motivating force in LBO transactions'.[4]

The present paper is similar to those of Mayer (1988), Shleifer and Summers (1988), Garvey and Swan (1991), Schnitzer (1995), Franks and Mayer (1992), and Chemla (1994) in recognizing the possibly detrimental effects of takeovers and leveraged buyouts when implicit contracting is valuable. It differs from Garvey and Swan (1991) in that it explicitly addresses shareholders' incentive to breach existing implicit contracts; from Schnitzer (1995) in that it does not assume that the raider has an informational advantage over initial shareholders; from Chemla (1994) in that it explicitly models the source of a raider's bargaining power; and from Mayer (1988) and Franks and Mayer (1992) in that it does not require that the owners of a firm be reluctant to breach the implicit contracts they have entered into, but be willing to breach those that were entered into by preceding owners. It is similar to Shleifer and Summers (1988), Garvey and Gaston (1991), and Burkart, Gromb, and Panunzi (1994) in viewing diffuse ownership as serving to deter shareholders from breaching existing implicit contracts; but it explicitly identifies the free-rider problem as the source of the benefits of diffuse ownership, and recognizes that the existence of both costs and benefits to diffuse ownership leads to an optimal level

[4] Perotti and Spier (1993) motivate the choice of high leverage by the desire of the shareholders of a firm to increase their bargaining power in forcing concessions from the employees of the firm, when renegotiating compensation contracts. Such renegotiation is made necessary by the need to remedy the underinvestment problem that is a consequence of the overhang created by the compensation owed employees. Perotti and Spier (1993) do not specifically address the reversion to diffuse ownership. Furthermore, their results, if applied to leveraged buyouts, would suggest that these should occur primarily in industries that have profitable growth opportunities. This is in contrast to existing empirical evidence (Jensen, 1993).

of diffusion of ownership. It differs from Degeorge and Zeckhauser (1993) in that it seeks to provide an explanation for the occurrence rather than the timing of reverse leveraged buyouts. In contrast, Degeorge and Zeckhauser (1993) assume that a leveraged buyout will eventually revert to public ownership, and consider the timing of the reversion to public ownership as it relates to the performance of the leveraged buyout. Finally, this paper does not consider the role of reputation in serving to enforce implicit contracts (e.g. Bull, 1987). The effectiveness of reputation in serving to deter the breach of implicit contracts by shareholders and raiders is likely to be much diminished by the presence of imperfect information, such as in times of dramatically changed competitive conditions when the distinction between the achievement of essential gains in efficiency and the breach of implicit contracts is difficult to establish.

The paper proceeds as follows: Section 1 examines the costs and the benefits of diffuse ownership. It establishes the existence of a level of diffusion of ownership that maximizes firm value. Section 2 examines the choices of concentration of ownership made over time by investors in leveraged buyouts, and establishes the result that firm value may be higher absent the flexibility afforded investors to alter over time the concentration of ownership. Section 3 concludes by using the theoretical results of Sections 1 and 2 to explain the empirical observation that motivated this paper.

1. Diffusion of Ownership

This section examines the costs and the benefits of diffuse ownership. Both are shown to be a consequence of the free-rider problem, the former because of decreased monitoring, the latter because of increased implicit contracting. The existence of both costs and benefits to diffuse ownership naturally implies the existence of some level of diffusion of ownership that maximizes firm value. This level equates the marginal gains from implicit contracting with those from monitoring when neither source of gains dominates.

1.1. MONITORING

Consider a one-period world, from time $t = 0$ to $t = 1$. An entrepreneur is endowed at time $t = 0$ with a project that yields net cash flow $\underline{R}$ at time $t = 1$. The entrepreneur wishes to sell the rights to the project to one or many investors, and seeks to determine the level of diffusion of ownership that will maximize his proceeds from selling the rights to the project. Whether sold to one or many investors, henceforth called the shareholders, the project must be managed by a professional manager. The management of the project is costless to the professional manager, whose reservation utility is zero and who is therefore offered a wage of

zero which he accepts.[5] The manager is, however, an 'empire-builder' (Jensen, 1986; Hart and Moore, 1990). He will, if not monitored by shareholders, invest not only in the project sold by the entrepreneur but also in a negative net present value project that will decrease net cash flow $\underline{R}$ by a fraction β.

The incentive a shareholder has to monitor the manager depends upon the costs and benefits of doing so. Her benefits are the share of the time $t = 1$ cash flow she receives. Her costs are those of identifying the expenses planned by the manager, determining their importance to the successful conduct of the project, and, should she deem some to be unnecessary to the project, obtaining the support of a majority of shareholders in barring the manager from making these expenses. Let c denote the costs borne by a shareholder who chooses to monitor the manager and, following Winton's (1993) analysis of the free-rider problem, let m denote the probability with which a shareholder chooses to monitor the manager. When the manager is monitored with probability m, his investment in the negative net present value project decreases net cash flow by a fraction $\beta(m)$. $\beta'(.) < 0, \beta''(.) > 0, \beta(0) = \beta$, and $\beta(1) = 0$. A higher probability of monitoring decreases the manager's ability to invest in the negative net present value project, and thus the decrease in net cash flow, but does so at a decreasing rate.[6]

We initially consider the case where the rights to the project are sold to a single investor, who becomes the sole shareholder of the closely-held firm that employs the manager. This investor solves the following problem at $t = 0$.

$$\underset{0 \leq m \leq 1}{\text{Max}}_{m} \; (1 - \beta(m))\underline{R} - mc.$$

This problem has first-order condition

$$-\beta'(m)\underline{R} - c + \lambda - \mu = 0$$

where λ and μ denote the Lagrange multipliers associated with the constraints $m \geq 0$ and $\mu \leq 1$ respectively. Under the assumption $-\beta'(1)\underline{R} > c$, $m = 1$ and the shareholder monitors with certainty.[7] The proceeds obtained by the entrepreneur from selling the firm therefore equal $\underline{R} - c$.

[5] This assumption is made for simplicity. The results of Section 1.1 only require that the incentives of the manager not be perfectly aligned with those of shareholders by the compensation contract, thus making the monitoring of the manager by shareholders beneficial to the latter.

[6] The results of Section 1.1 would remain unchanged if $\beta(m)$ were a linear function of m of the form $\beta \times (1 - m)$. The assumption of strict convexity of $\beta(.)$ serves to make possible the existence of an interior solution to the problem considered in Section 1.3. It can be justified by viewing a shareholder as exerting an effort that results in the successful monitoring of the manager with some probability that is an increasing and strictly concave function of the effort exerted by the shareholder. The expected decrease in cash flow, which is a decreasing and linear function of the probability of successful monitoring, is therefore a decreasing and convex function of the effort exerted by the shareholder. It is assumed to be a convex function of the probability of successful monitoring for simplicity.

[7] The assumption $-\beta'(1)\underline{R} > c$ ensures that it is socially efficient to monitor with certainty. The free-rider problem associated with diffuse ownership is then shown to preclude monitoring with certainty in spite of its social efficiency.

Now consider the case where the rights to the project are sold to N investors, who become identical shareholders in the firm. Each shareholder i, $i \in \{1, N\}$, solves the following problem at time $t = 1$

$$\underset{\substack{m_i \\ 0 \le m_i \le 1}}{\text{Max}} \frac{(1 - \beta(M))\underline{R}}{N} - m_i c$$

where $M = 1 - \Pi_{i=1}^{N}(1 - m_i)$ is the overall probability of monitoring. This problem has first-order condition

$$\frac{-\beta'(M)\underline{R}}{N}\frac{\partial M}{\partial m_i} - c + \lambda - \mu = 0$$

$$\Leftrightarrow \frac{-\beta'(1 - (1 - m)^N)\underline{R}}{N}(1 - m)^{N-1} - c + \lambda - \mu = 0, \tag{1}$$

recognizing that $m_1 = m_2 = \cdots = m_N \equiv m$ as all N shareholders are identical.[8]

Equation (1) indicates that, for $c > 0$, m must be less than 1, as the Lagrange multiplier μ associated with the constaint $m \le 1$ would be negative, clearly a contradiction, if m were assumed to equal 1. Monitoring with certainty by every shareholder cannot constitute an equilibrium, as inherent to such an equilibrium is the contradiction between its requirement that every shareholder monitors with certainty and the incentive every shareholder would then have not to monitor. A shareholder that would choose not to monitor would free herself from the costs of monitoring, yet be confident that her benefits would remain unchanged, in view of the certain monitoring by other shareholders specified by the equilibrium. She would, in effect, be free-riding on the monitoring performed by other shareholders.

We now establish the result that the entrepreneur will choose to sell the rights to the project to a single investor rather than to a multitude of investors, as his proceeds will be maximized by doing so. His proceeds are $\underline{R} - c$ if selling the firm to a single investor, $(1 - \beta(M))\underline{R} - Nmc$ if selling the firm to a multitude of investors, each monitoring with probability m, $0 < m < 1$.[9] Concentrated ownership thus serves to achieve higher firm value than does diffuse ownership when the task to be performed by shareholders is the monitoring of management.

Lemma 1: The inequality

$$(1 - m)^N > 1 - Nm$$

[8] The assumption of symmetric equilibrium is made for simplicity. It is not necessary for our results, as the mere presence of more than one shareholder suffices to introduce a discrepancy between the costs and the benefits of monitoring, thus creating a free-rider problem.

[9] If $m = 0$, as would be the case when $-\beta'(0)\underline{R}/N < c$, the proceeds from selling the firm to a multitude of investors are $(1 - \beta)\underline{R}$. These are clearly smaller than the proceeds $\underline{R} - c$ obtained from selling the firm to a single investor, as $\beta\underline{R} = \beta(0)\underline{R} > (\beta(1) - \beta'(1))\underline{R} = -\beta'(1)\underline{R} > c$. The first inequality is true by the convexity of $\beta(.)$.

is true for all $N \geq 2$ and $0 < m < 1$.

Proof: See Appendix.

Proposition 1: Concentrated ownership serves to achieve higher firm value than does diffuse ownership when the task to be performed by shareholders is the monitoring of management.

Proof: See Appendix.

Proposition 1 illustrates the well-known free-rider problem as it applies to the monitoring of management, and establishes the lower value of a firm that is widely-held and whose shareholders insufficiently monitor management. Diffuse ownership is therefore costly to shareholders. We now seek to show that it can also be beneficial to them.

1.2. Implicit Contracting

Now consider the case where the entrepreneur is endowed at time $t = 0$ with a project that yields cash flow $R(e)$, $R'(.) > 0$ and $R''(.) < 0$, at time $t = 1$. e is the effort exerted at time $t = 0$ at a cost $\phi(e)$, $\phi'(.) > 0$ and $\phi''(.) > 0$, by an employee of the firm. In compensation for exerting the effort e at time $t = 0$, this employee is promised by the manager of the firm, who is acting on behalf of its shareholders, a fraction α of the cash flow $R(e)$ at time $t = 1$. e is non-contractible as it is assumed not to be observable. α is non-contractible as the employee can be fired between times $t = 0$ and $t = 1$. e and α are therefore the object of an implicit contract between the employee and the manager acting on behalf of shareholders.

Examples of implicit contracts between employees and firms are promises of lifetime employment followed by mandatory retirement (Lazear, 1979, 1991), and defined-benefit pension plans that specify pension payments and contributions that are based upon final rather than current salaries (Ippolito, 1985; Petersen, 1992). Such arrangements serve to discourage older employees from shirking, by paying them more than their marginal product of labor, thus restoring the effectiveness of the threat of dismissal for older employees who attach a greater value to leisure (Lazear, 1979, 1991). As employees are paid more than their marginal product of labor when old, they must be paid less than their marginal product of labor when young. This provides an incentive for firms to fire older employees who, after having been paid less than their marginal product of labor when young, are now to be paid more than their marginal product of labor (Garvey and Gaston, 1991).[10]

Firing the employee after he has exerted the effort e at time $t = 0$ constitutes a breach of the implicit contract. The manager will not do so of his own accord: it is

[10] The arrangements we have described can only be the object of implicit contracts between firms and employees, as any explicit contract that would specifically forbid firms from firing employees in the later stages of their careers would defeat the very purpose of such arrangements, which is to restore the effectiveness of the threat of dismissal.

an unpleasant task which he would rather avoid, and he might be reluctant to renege on the promises of deferred compensation he has made to employees (Shleifer and Summers, 1988), especially as, not being a shareholder, he has nothing to gain from doing so. Shareholders must therefore put pressure on the manager, and threaten him with dismissal if necessary, in order to have him fire the worker. Let k be the cost borne by a shareholder who chooses to put pressure on the manager, and let b denote the probability with which she chooses to do so. For simplicity, b will be referred to as the probability of breach, and shareholders who put pressure on the manager in order to have him breach existing implicit contracts will be said to breach. By analogy to Section 1.1, assume that α is a function of b with $\alpha'(.) < 0$, $\alpha''(.) > 0$, $\alpha(0) = \alpha$, and $\alpha(1) = 0$.

Initially consider the case where the firm is closely-held. Let e^1 denote the effort exerted by the employee at time $t = 0$.[11] The sole shareholder's problem at time $t = 1$ is

$$\underset{\substack{b \\ 0 \leq b \leq 1}}{\text{Max}} \; (1 - \alpha(b))R(e^1) - bk.$$

This problem has first order condition

$$-\alpha'(b)R(e^1) - k + \lambda - \mu = 0.$$

The employee can preclude breach by choosing e^1 to be such that

$$-\alpha'(0)R(e^1) - k = 0. \tag{2}$$

In order to simplify the forthcoming analysis, we will assume that the employee always chooses to do so.[12] The value of the closely-held firm therefore equals $(1 - \alpha)R(e^1)$.

Now consider the case where the firm is widely-held. Let e^N denote the effort exerted by the employee at time $t = 0$. Each shareholder i, $i \in \{1, N\}$, solves the following problem at time $t = 1$

$$\underset{\substack{b_i \\ 0 \leq b_i \leq 1}}{\text{Max}} \; \frac{1 - \alpha(B)}{N} R(e^N) - b_i k$$

where $B = 1 - \Pi_{i=1}^{N}(1 - b_i)$ is the overall probability of breach. This problem has first-order condition

$$\frac{-\alpha'(B)R(e^N)}{N} \frac{\partial B}{\partial b_i} - k + \lambda - \mu = 0$$

[11] The superscript 1 on the level of effort e refers to the sole shareholder of the firm.

[12] The robustness of our results to this assumption will be examined in Section 3. Note however that a sufficient condition for the employee always to choose to preclude breach is that $\alpha(b)/-\alpha'(b)$ is decreasing in b. In such a case, the employee will refrain from exerting a level of effort greater than that precluding breach, for the larger payoff he would receive in case breach were not to occur would fail to offset the lower probability of receiving this payoff.

$$\Leftrightarrow \frac{-\alpha'(1-(1-b)^N)R(e^N)}{N}(1-b)^{N-1} - k + \lambda - \mu = 0 \tag{3}$$

recognizing that $b_1 = b_2 = \cdots = b_N \equiv b$ as all N shareholders are identical.

As in the case of monitoring, no equilibrium in which all shareholders breach with certainty can exist, and b is therefore strictly less than 1. As in the case of a single shareholder, we will assume that the employee chooses a level of effort e^N that precludes breach by shareholders.[13] e^N is such that

$$\frac{-\alpha'(0)R(e^N)}{N} - k = 0 \tag{4}$$

and the employee's payoff is $\alpha R(e^N) - \phi(e^N)$.

The value of the widely-held firm equals $(1-\alpha)R(e^N)$. It is greater than $(1-\alpha)R(e^1)$ as a comparison of equations (2) and (4) reveals that $e^N > e^1$. We have thus proved

Proposition 2: Diffuse ownership serves to achieve higher firm value than does concentrated ownership in the presence of valuable implicit contracting opportunities.

Proposition 2 has proved that diffuse ownership can be beneficial to shareholders. Diffuse ownership results in a free-rider problem that decreases a shareholder's incentive to initiate breach, and therefore increases the level of effort that the employee can exert without fear of breach. The higher level of effort exerted by the employee leads to higher firm value than in the case of concentrated ownership.

1.3. Monitoring and Implicit Contracting

This section combines Sections 1.1 and 1.2 to establish the existence of a level of diffusion of ownership that maximizes firm value. This level equates the marginal gains from monitoring with those from implicit contracting when neither source of gains dominates.

We first establish the following Lemmas. These are immediate generalizations of the results in Sections 1.1 and 1.2.

Lemma 2: The probability of monitoring m chosen by a shareholder, the overall probability of monitoring M, and the gains from monitoring $(1-\beta(M))\underline{R} - Nmc$ decrease in the number of shareholders N.

Proof: See Appendix.

[13] A sufficient condition for this to be the case is that $\alpha(B)/-\alpha'(B)(\partial B/\partial b_i)|b_i = b$ is decreasing in b. This would be true if $\alpha(B)$ were a linear function of B of the form $\alpha \times (1-B)$, for example.

Lemma 3: The effort e exerted by the employee and the gains from implicit contracting $(1-\alpha)R(e)$ increase in the number of shareholders N. $e^1 \leq e \leq e^{\max}$, where $e^{\max}$ maximizes $\alpha R(e) - \phi(e)$.

Proof: See Appendix.

Now consider the case where the project has cash flows $\underline{R}$ and $R(e)$ at time $t = 1$. The entrepreneur's problem at time $t = 0$ is

$$\underset{\substack{N \\ 1 \leq N \leq N^{\max}}}{\text{Max}} \quad (1-\beta(M))\underline{R} - Nmc + (1-\alpha)R(e) \tag{5}$$

where $N^{\max}$ denotes the level of diffusion of ownership that corresponds to $e^{\max}$. When neither source of gains dominates, this problem has interior solution N^*, $1 < N^* < N^{\max}$, which satisfies the first-order condition

$$-\beta'(M)\underline{R}\frac{\partial M}{\partial N} - mc - Nc\frac{\partial m}{\partial N} + (1-\alpha)R'(e)\frac{\partial e}{\partial N} = 0. \tag{6}$$

The optimal level of diffusion of ownership thus equates the marginal gains from monitoring with those from implicit contracting. The gains from monitoring decrease, and the gains from implicit contracting increase, as ownership becomes more diffuse. We have thus proved

Proposition 3: In the presence of gains from monitoring and from implicit contracting, there exists a level of diffusion of ownership that maximizes firm value. This level equates the marginal gains from monitoring to those from implicit contracting when neither source of gains dominates.

We henceforth assume that the function $\beta(.)$ is such that the gains from monitoring constitute a strictly concave function of N.[14] As the gains from implicit contracting have been shown in the proof of Lemma 3 to constitute a linear function of N, the entire value of the firm constitutes a strictly concave function of N. The strict concavity of firm value will be central to our analysis of leveraged buyouts, which is predicated upon the existence of an interior solution to the joint problem of monitoring and implicit contracting.

The strict concavity of firm value also makes possible the comparative statics analysis of the optimal level of diffusion of ownership N^*. In order to do so, write cash flows $\underline{R}$ and $R(e)$ as $\gamma\underline{\gamma}\underline{r}$ and $\gamma\gamma_e r(e)$, respectively. γ, $\underline{\gamma}$ and γ_e are intended to index firm size, the potential gains from monitoring, and those from implicit contracting, respectively. The simple differentiation of equation (6) then reveals that $(\partial N^*)/(\partial\underline{\gamma}) < 0$, $(\partial N^*)/(\partial\gamma_e) > 0$, and $\partial N^*/\partial\gamma$ is indeterminate. Not

[14] If the function $\beta(m)$ were a linear function of m of the form $\beta \times (1-m)$, the gains from monitoring could be shown to be a linear function of N. The role of the convexity of $\beta(m)$, or the concavity of $-\beta(m)$, is to concavify the gains from monitoring.

surprisingly, larger gains from monitoring imply more concentrated ownership, whereas larger gains from implicit contracting imply more diffuse ownership. Perhaps surprisingly, the effect of firm size on the optimal level of diffusion of ownership cannot be determined. This is because firm size affects both the gains from monitoring and those from implicit contracting, with conflicting effects on N^*.

2. Leveraged Buyouts

Leveraged buyouts make possible a change in the concentration of ownership following the choice of effort by employees. They thus provide investors in leveraged buyouts with the opportunity to breach existing implicit contracts, should employees not have foreseen the occurrence of a leveraged buyout. Proposition 4 shows that, in the one-period world of Section 1, a firm will be acquired by a single investor following the choice of effort by the employee, as the prior choice of effort by the employee of the firm transforms the implicit contracting problem of Section 1.2 into a problem similar to the monitoring problem of Section 1.1.

Lemma 4: The probability of breach b chosen by a shareholder and the overall probability of breach B decrease in the number of shareholders N. The gains from breaching existing implicit contracts $(1-\alpha(B))R(e)-Nbc$ constitute a decreasing function of N.

Proof: The proof is analogous to that of Lemma 2.

Proposition 4: In a one-period world in which leveraged buyouts are possible, a firm is acquired by a single investor.

Proof: See Appendix.

Note that the firm will be acquired by a single investor regardless of the employee's choice of effort. Should the employee not have foreseen the occurrence of a leveraged buyout, and have chosen to exert the level of effort e^i corresponding to the level of diffusion of ownership N^i prevailing prior to the buyout, single ownership would maximize both the gains from monitoring and those from breaching existing implicit contracts. Should the employee have correctly foreseen the occurrence of a leveraged buyout, and have chosen to exert the level of effort e^1 that precludes breach, single ownership would maximize the gains from monitoring in the absence of any gain from breaching existing implicit contracts. Firm value does of course differ in those two cases: it is $\underline{R}-c+(1-\alpha(b^1))R(e^i)-b^1k$ in the presence of gains from breaching existing implicit contracts, and $\underline{R}-c+(1-\alpha)R(e^1)$ in their absence. b^1 denotes the probability of breach in the case of single ownership. We shall assume that $N^i > N^* > 1$, as the stated purpose of leveraged buyouts is to concentrate the ownership of firms whose ownership has become excessively diffuse (Jensen, 1993).

It is interesting to compare $\underline{R} - c + (1 - \alpha(b^1))R(e^i) - b^1K$ and $\underline{R} - c + (1 - \alpha)R(e^1)$ to the maximal value of the firm in the absence of the possibility of leveraged buyout. The latter equals $(1 - \beta(M^*))\underline{R} - N^*m^*c + (1 - \alpha)R(e^*)$, where e^*, m^*, and M^* denote the level of effort and probabilities of monitoring corresponding to the optimal level of diffusion of ownership N^*.

As $N^i > N^*$, $e^i > e^*$ by Lemma 3. We then have

$$\begin{aligned}\underline{R} - c + (1 - \alpha(b^1))R(e^i) - b^1k \\ > (1 - \beta(M^*))\underline{R} - N^*m^*c + (1 - \alpha)R(e^*) \\ > \underline{R} - c + (1 - \alpha)R(e^1)\end{aligned}$$

The first inequality is a direct consequence of Lemmas 2 and 4, and of the inequality $e^i > e^*$. The second inequality is immediate from the definition of N^* as the level of diffusion of ownership that maximizes firm value in the absence of breach, for foresight by employees precludes breach even in the case of a leveraged buyout.

The preceding inequalities express both the advantages and the disadvantages of leveraged buyouts. If unforeseen by employees, leveraged buyouts can be beneficial to shareholders, who stand to gain not only from increased monitoring, but also from the breach of existing implicit contracts. In contrast, leveraged buyouts that are foreseen by employees can be detrimental to shareholders, as employees who fear the breach of their implicit contracts will refrain from making the level of non-contractible effort that maximizes firm value. By preventing shareholders from committing to a given level of diffusion of ownership, leveraged buyouts preclude valuable implicit contracting.

We now extend the one-period world that has thus far been considered to a two-period world, from time $t = 0$ to time $t = 2$, in which successive employees exert effort at the beginning of each period, at times $t = 0$ and $t = 1$. Our purpose in so doing is to examine the variation in the concentration of ownership over time. We thus assume that the level of diffusion of ownership, which is N^i at time $t = 0$ and can be changed between times $t = 0$ and $t = 1$, thus representing a leveraged buyout, can further be changed at time $t = 1$ and between times $t = 1$ and $t = 2$. The possible change at time $t = 1$, prior to the choice of effort by the employee, represents a reverse leveraged buyout. The possible change between times $t = 1$ and $t = 2$, following the choice of effort by the employee at time $t = 1$, represents a second leveraged buyout, as sometimes occurs (Kaplan, 1991; Van De Gucht and Moore, 1994). Let $0 < \delta < 1$ denote the discount factor.

As in the one-period world of Proposition 4, we shall examine two cases: the case in which the employee does not foresee at time $t = 0$ the occurrence of a leveraged buyout in the first period, and thus exerts the effort e^i that corresponds to the initial level of diffusion of ownership N^i, and the case in which the employee does foresee the occurrence of a leveraged buyout. The former case clearly implies a lack of foresight on the part of the employee at time $t = 0$. Such a lack of

foresight is suggested by the actual occurrence of breach (Lichtenberg and Siegel, 1990), and will be further discussed in Section 3. The latter case will be considered in Section 2.2. We shall show that a succession of a leveraged buyout and a reverse leveraged buyout can be observed in both cases.

2.1. Lack of Foresight

Recall that our purpose is to examine the variation in the concentration of ownership over time, specifically the initial choice of very highly concentrated ownership followed by that of more diffuse ownership. In the case where leveraged buyouts are costless, however, no reversal to more diffuse ownership occurs following the initial choice of very highly concentrated ownership. This is shown in Proposition 5.

Proposition 5: In the case where leveraged buyouts are costless, the firm is acquired by a single investor in the first period. It remains closely-held in the second period.

Proof: See Appendix.

Proposition 5 indicates that the firm is indeed acquired by a single investor in the first period. There is no reversion to more diffuse ownership, however, for any such reversion would fail in its intended purpose of eliciting from the employee a level of effort greater than that corresponding to single ownership e^1. The employee would be aware that diffuse ownership would not be maintained, as shareholders would gain by concentrating ownership yet again.

In contrast to Proposition 5, Proposition 6 indicates that a reversion to diffuse ownership does indeed occur in the case where leveraged buyouts are costly, as such costs can serve to preclude increases in the concentration of ownership that are motivated primarily by the desire to breach existing implicit contracts.[15] To see this, let c_l denote the cost of a leveraged buyout and assume

$$\begin{aligned}
&\underline{R} - c + (1 - \alpha(b^1))R(e^*) - b^1 k \\
&\quad -((1 - \beta(M^*))\underline{R} - N^* m^* c + (1 - \alpha)R(e^*)) < c_l < \qquad (7) \\
&\underline{R} - c + (1 - \alpha(b^1))R(e^i) - b^1 k \\
&\quad +\delta((1 - \beta(M^*))\underline{R} - N^* m^* c + (1 - \alpha)R(e^*)) \\
&\quad -(1 + \delta)((1 - \beta(M^i))\underline{R} - N^i m^i k + (1 - \alpha)R(e^i))
\end{aligned}$$

The purpose of assumption (7) is simply to ensure that the costs of a leveraged buyout are low enough not to preclude that of a firm that has excessively diffuse

[15] We shall assume for simplicity that reverse leveraged buyout are costless. The robustness of our results to this assumption will be examined in Section 3.

ownership N^i, yet are high enough to preclude that of a firm that has the optimal level of diffusion of ownership N^*. It is made possible by the larger gains from concentrating ownership in the case of the former. We can now show

Proposition 6: Under assumption (7), the firm is acquired by a single investor in the first period. It is then sold to N^* investors at time $t = 1$, thus making possible the conclusion of new implicit contracts. No further changes in the concentration of ownership occur.

Proof: See Appendix.

Proposition 6 constitutes the main result of this paper. It provides an explanation for the lack of permanence of highly concentrated ownership or, equivalently, for the initial and temporary choice of highly concentrated ownership when the maximization of firm value requires that there be some diffusion of ownership. Recall that the optimal level of diffusion of ownership N^*, although smaller than the initial level of diffusion of ownership N^i, is nonetheless greater than 1. Following the choice at time $t = 0$ of effort level e^i by the employee who does not foresee breach, investors in a leveraged buyout will maximize their first-period gains by choosing single ownership. They then proceed at time $t = 1$ to the choice of the optimal level of diffusion of ownership N^*, thus maximizing firm value by entering into new implicit contracts. In contrast to the case of Proposition 5, the employee is willing to enter into such contracts: there will be no further changes in the level of diffusion of ownership, for any gain thus obtained would be smaller than the costs of a leveraged buyout. The breach of implicit contracts is thus incidental to the desire to achieve the gains in efficiency that can be obtained by concentrating the level of diffusion of ownership from N^i to N^*. It explains not the occurrence of a leveraged buyout but the initial choice of highly concentrated ownership.

2.2. FORESIGHT

Now consider the case where the employee does foresee the occurrence of a leveraged buyout, and therefore exerts at time $t = 0$ a level of effort that precludes breach. We shall show that, in such a case, the flexibility afforded investors in leveraged buyouts to alter over time the concentration of ownership might lead to lower firm value than in the absence of such flexibility.

In the case where single ownership is initially chosen, and is followed by a reversion to more diffuse ownership, the employee now exerts the level of effort e^1 at time $t = 0$.[16] The firm therefore has value

$$\underline{R} - c + (1 - \alpha)R(e^1) + \delta((1 - \beta(M^*))\underline{R} - N^* m^* c + (1 - \alpha)R(e^*)) - c_l. \tag{8}$$

[16] A sufficient condition for a leveraged buyout to occur in the case of foresight is that assumption (8) holds with $(1 - \alpha(b^1))R(e^1)$ replacing $(1 - \alpha(b^1))R(e^i)$.

In the contrasting case where the level of diffusion of ownership chosen upon buyout must be maintained over both periods, the firm has value

$$(1-\beta(M^2))\underline{R} - N^2m^2c + (1-\alpha)R(e^2)$$
$$+\delta((1-\beta(M^2))\underline{R} - N^2m^2c + (1-\alpha)R(e^2))) - c_l. \tag{9}$$

N^2 denotes the level of diffusion of ownership that is chosen in the first period in the case where no further change is possible. e^2, m^2, and M^2 denote the corresponding level of effort and probabilities of monitoring. N^2 solves the problem

$$\underset{1\leq N\leq N^{\max}}{\underset{N}{\text{Max}}} \quad (1-\beta(M))\underline{R} - Nmc + (1-\alpha(B))R(e^2) - Nbk$$
$$+\delta((1-\beta(M))\underline{R} - Nmc + (1-\alpha)R(e)) \tag{10}$$

which has first-order condition

$$-\beta'(M)\underline{R}\frac{\partial M}{\partial N} - mc - Nc\frac{\partial m}{\partial N} - \alpha'(B)R(e^2)\frac{\partial B}{\partial N} - bk - Nk\frac{\partial b}{\partial N}$$
$$+\delta\left[-\beta'(M)\underline{R}\frac{\partial M}{\partial N} - mc - Nc\frac{\partial m}{\partial N} + (1-\alpha)R'(e)\frac{\partial e}{\partial N}\right] = 0. \tag{11}$$

Note the contrasting treatment of implicit contracts in the two periods: existing implicit contracts corresponding to the level of effort e^2 exerted by the employee at time $t = 0$ are to be breached in the first period, and new implicit contracts are to be entered into at time $t = 1$. The chosen level of diffusion of ownership N^2 thus trades-off the gains from monitoring, from breaching existing implicit contracts, and from entering into new implicit contracts over the second period. A comparison of first-order conditions (6) and (11) reveals that $N^* > N^2$: the ability to gain from the breach of existing implicit contracts leads investors to choose less diffuse ownership than that which maximizes firm value over a single period. Investors do not, however, choose single ownership. Although such a choice would maximize their first-period gains, it would preclude them from entering into valuable implicit contracts in the second period.

The employee does of course realize that his choice of effort at time $t = 0$ may expose him to breach in the first period. He therefore chooses his level of effort to be such as to preclude breach. e^2 is thus the solution to

$$\frac{-\alpha'(0)R(e^2)}{N^2} - k = 0. \tag{12}$$

From $N^* > N^2 > 1$, we have $e^* > e^2 > e^1$ by Lemma 3. We can now show

Proposition 7: Firm value may be higher when investors do not have the flexibility to alter over time the concentration of ownership of the firm they have acquired.

Proof: See Appendix.

Proposition 7 shows that in the case where the employee foresees the change in the concentration of ownership in the first period, firm value may be higher when investors in a leveraged buyout are denied the flexibility to alter the concentration of ownership over time. The absence of such flexibility serves to commit investors to the choice of more diffuse ownership than they would in its presence, thus inducing the employee to exert the greater level of effort that leads to higher firm value.

3. Discussion and Conclusion

The seemingly paradoxical observation described in the introduction can be explained by the results of Proposition 6. Investors in leveraged buyouts choose very high levels of concentration of ownership upon their acquisition of a firm (Jensen, 1993). These very high levels of concentration of ownership make possible very sizeable gains in efficiency (Dial, 1994; Kaplan, 1989; Lichtenberg and Siegel, 1990; Muscarella and Vetsuypens, 1990; Palepu, 1990; Smith, 1990). They also result in the breach of existing implicit contracts (Lichtenberg and Siegel, 1990). Within a few years, investors sell all or part of their shareholdings in the leveraged buyout (Kaplan, 1991; Van De Gucht and Moore, 1995), through a reverse leveraged buyout that nonetheless maintains a higher level of concentration of ownership than prevailing prior to the buyout (Dial, 1994; Holthausen and Larcker, 1996; Kaplan, 1991).[17] They do so in spite of the decline in performance that follows the decrease in the concentration of ownership (Degeorge and Zeckhauser, 1993; Dial, 1994; Holthausen and Larcker, 1996), as diffuse ownership permits the conclusion of implicit contracts with employees (Garvey and Gaston, 1991).[18]

The extent to which implicit contracts are breached following leveraged buyouts and takeovers has been much studied following Shleifer and Summers' (1988) suggestion that transfers from employees and other stakeholders of a firm, such as its suppliers, might account for the largest part of takeover premia (Kaplan, 1989; Bhagat, Shleifer, and Vishny, 1990; Pontiff, Shleifer, and Weisbach, 1990; Rosett, 1990; Smith, 1990). Lichtenberg and Siegel's (1990) work appears the be the most comprehensive, as it examines changes in productivity and employment at plant level. Lichtenberg and Siegel (1990) find that 'the employment and compensation of white-collar workers decline following buyouts, but those of blue collar workers are unchanged . . . there are sharp and significant reductions in nonproduction worker employment; the cumulative decline is 8.5%'. Their results suggest the breach of

[17] Kaplan (1991) finds that the median time during which leveraged buyouts remain private is 6.82 years. He concludes that the majority of leveraged buyouts are 'neither short-lived, nor permanent'.

[18] Garvey and Gaston (1991) find implicit contracts to be more common among widely-held firms. No empirical work addresses the specific case of reverse leveraged buyouts, however.

implicit contracts, as white-collar workers are those most likely to have entered into implicit contracts with their firms (Lazear, 1979; Hutchens, 1986, 1987).

The gains from breaching existing implicit contracts are not negligible (Lichtenberg and Siegel, 1990). However, when compared to the gains from increased efficiency, they are too small for the desire to breach implicit contracts to constitute the primary motivation for the occurrence of a leveraged buyout (Kaplan, 1989; Bhagat, Shleifer, and Vishny, 1990; Palepu, 1990; Pontiff, Shleifer, and Weisbach, 1990; Rosett, 1990; Smith, 1990). This observation, combined with the observation that reverse leveraged buyouts maintain a higher level of concentration of ownership than that prevailing prior to the buyout (Dial, 1994; Holthausen and Larcker, 1996; Kaplan, 1991), suggest that the desire to breach implicit contracts should be incidental to that of increasing efficiency through the transformation of a firm that has excessively diffuse ownership into one that has the optimal level of diffusion of ownership, and that no change in the concentration of ownership should occur once the optimal level of diffusion of ownership has been attained. That the level of diffusion of ownership prevailing prior to the buyout should have become excessively diffuse, thus necessitating its concentration through a leveraged buyout, may be a consequence of dramatically changed competitive conditions, such as described and analyzed by Jensen (1993).

The actual occurrence of the breach of implicit contracts (Lichtenberg and Siegel, 1991) suggests that employees did not foresee that such contracts would be breached upon leveraged buyout. This might be explained by the relatively recent appearance of leveraged buyouts. In equilibrium, however, employees will foresee the breach of implicit contracts in case of leveraged buyout, and accordingly decrease their level of non-contractible effort. This observation has motivated Proposition 7, which has argued that firm value might be higher were investors in leveraged buyouts compelled to choose the optimal level of concentration of ownership at the outset, by being denied the flexibility to alter over time the concentration of ownership. By analogy to Keynes' (1936) view that 'to make the purchase of an investment permanent and indissoluble ... might ... force the investor to direct his mind to the long-term prospects, and to those only', Proposition 7 can therefore be viewed as arguing that 'to make the choice of the level of concentration of ownership permanent and indissoluble might force the leveraged buyout team to direct its mind to the level of concentration of ownership that maximizes firm value, and to that level only'. The choice of the conditional tense is appropriate, as any normative implication Proposition 7 might have is extremely tentative. The interest presented by Proposition 7 resides instead, in our view, in the link it establishes between flexibility, duration in time, and value in the context of leveraged buyouts.[19]

[19] Links of a similar nature have been studied in the context of takeovers (Mayer, 1988; Franks and Mayer, 1990), and firm-creditor relationships (James and Weir, 1990; Hoshi, Kashyap, and Scharfstein, 1990a, b, 1991; Petersen and Rajan, 1994; Rajan, 1992).

We conclude by briefly discussing the robustness of our results to some of the assumptions that were made. These are the assumption that employees choose to exert a level of effort that precludes the breach of implicit contracts, the assumption that the level of diffusion of ownership N^i prevailing prior to the leveraged buyout does not equal the level N^* that maximizes firm value, and the assumption that reverse leveraged buyouts are costless. The first assumption served to simplify our analysis, but can be replaced by the much weaker assumption that maximizing the gains from implicit contracting requires some diffusion of ownership.[20] Dispensing with the third assumption by assuming that reverse leveraged buyouts are costly would simply restrain the range of parameters for which the results of Proposition 6 hold. The additional gains made possible by the initial and temporary choice of highly concentrated ownership, rather than the immediate choice of the level of concentration of ownership that maximizes firm value, would need to be larger than the cost of a reverse leveraged buyout. The second assumption is, however, essential to our results. Indeed, the first inequality in equation (8) implies that no change in the level of diffusion of ownership will occur following the choice of the level of diffusion of ownership that maximizes firm value. Any gain thus obtained, by breaching existing implicit contracts for example, would be lower than the cost of effecting this change through another leveraged buyout.

Appendix

Proof of Lemma 1: The proof is by induction. The inequality is certainly true for $N = 2$, as it is then

$$(1-m)^2 > 1-2m \Leftrightarrow 1+m^2-2m > 1-2m \Leftrightarrow m^2 > 0$$

which is true as $m > 0$.

Now assume that the inequality is true for $N > 2$, and let us show that it is also true for $N+1$. We will do so by contradiction. Let us therefore assume that

$$\begin{aligned}(1-m)^{N+1} &\leq 1-m(N+1)\\ &\Leftrightarrow (1-m)^N - m(1-m)^N \leq 1-Nm-m\\ &\Leftrightarrow 0 \leq (1-m)^N-(1-Nm) \leq m(1-m)^N - m < 0\end{aligned}$$

where the first inequality is true by assumption, and the third inequality is true as $0 < m < 1$. The last expression is clearly a contradiction. Q.E.D.

Proof of Proposition 1: We wish to prove the inequality

$$(1-\beta(M))\underline{R} - Nmc < \underline{R} - c.$$

[20] Our analysis would clearly be of no interest if that were not the case, for single ownership would then maximize firm value at all times.

We will do so by contradiction. Assume that

$$(1-\beta(M))\underline{R}-Nmc \geq \underline{R}-c \Leftrightarrow \beta(1-(1-m)^N)\underline{R}+Nmc \leq c$$

$$\Leftrightarrow \beta(1-(1-m)^N)\underline{R} \leq (1-Nm)c$$

$$\Leftrightarrow \beta(1)\underline{R}-\beta'(1)(1-m)^N\underline{R} < \beta(1-(1-m)^N)\underline{R} \leq (1-Nm)c$$

$$\Leftrightarrow -\beta'(1)(1-m)^N\underline{R} < (1-Nm)c$$

but this last inequality is false by the assumption $-\beta'(1)\underline{R} > c$ made in order to ensure that a sole shareholder monitors with certainty and by the inequality $(1-m)^N > 1-Nm$ proved in Lemma 1. Q.E.D.

Proof of Lemma 2: Apply the Implicit Function Theorem to equation (1) to obtain

$$\frac{\partial m}{\partial N} = \frac{\beta'(M)(1-m)+N\beta''(M)\ln(1-m)(1-m)^{N+1}-N\beta'(M)\ln(1-m)(1-m)}{N^2\beta''(M)(1-m)^N-N(N-1)\beta'(M)}$$

$$\Leftrightarrow \frac{\partial m}{\partial N} = \frac{\beta'(M)(1-m)}{N(N\beta''(M)(1-m)^N-(N-1)\beta'(M))}$$

$$+\ln(1-m)(1-m)\left[\frac{\beta''(M)(1-m)^N-\beta'(M)}{N\beta''(M)(1-m)^N-(N-1)\beta'(M)}\right] \leq 0 \qquad \text{(A1)}$$

with equality at $m=0$. Recall that $M=1-(1-m)^N$, differentiate with respect to N, and substitute the expression for $\partial m/\partial N$ obtained in equation (A1) to obtain

$$\frac{\partial M}{\partial N} = N(1-m)^{N-1}\frac{\partial m}{\partial N}-\ln(1-m)(1-m)^N \qquad \text{(A2)}$$

$$\Leftrightarrow \frac{\partial M}{\partial N} = \frac{\beta'(M)(1-m)^N}{N\beta''(M)(1-m)^N-(N-1)\beta'(M)}$$

$$+\ln(1-m)(1-m)^N\left(\frac{\beta''(M)(1-m)^N-\beta'(M)}{\beta''(M)(1-m)^N-\frac{N-1}{N}\beta'(M)}-1\right) \leq 0 \text{(A3)}$$

with equality at $m=M=0$. Finally, differentiate $(1-\beta(M))\underline{R}-Nmc$ with respect to N to obtain

$$-\beta'(M)\underline{R}\frac{\partial M}{\partial N}-mc-Nc\frac{\partial m}{\partial N}$$

$$=-\beta'(M)\underline{R}\left(\frac{\partial M}{\partial N}-(1-m)^{N-1}\frac{\partial m}{\partial N}-(1-m)^{N-1}\frac{m}{N}\right)$$

$$= -\beta'(M)\underline{R}(1-m)^{N-1}\left((N-1)\frac{\partial m}{\partial N} - (1-m)\ln(1-m) - \frac{m}{N}\right)$$

where the first equality is obtained by using equation (1) and the second equality is obtained by substituting the expression for $\partial M/\partial N$ obtained in equation (A2). We will show that the term in parentheses is negative. Substituting the expression for $\partial m/\partial N$ obtained in equation (A1), this term becomes

$$(N-1)\frac{\beta'(M)(1-m)}{N\beta''(M)(1-m)^N - (N-1)\beta'(M)} + \ln(1-m)(1-m)$$

$$\times\left(\frac{\beta''(M)(1-m)^N - \beta'(M)}{\frac{N}{N-1}\beta''(M)(1-m)^N - \beta'(M)} - 1\right) - \frac{m}{N}.$$

The first term is clearly negative. Rewrite the last two terms as

$$\frac{1}{N}\left(-\ln(1-m)(1-m)\left(\frac{\beta''(M)(1-m)^N}{\beta''(M)(1-m)^N - \frac{(N-1)}{N}\beta'(M)}\right) - m\right) \leq 0$$

where the inequality is true by the relation $-(1-m)\ln(1-m) \leq m$ for $0 \leq m \leq 1$, with equality at $m = 0$ (Winton, 1993). Q.E.D.

Proof of Lemma 3: Apply the Implicit Function Theorem to Equation (4) to obtain

$$\frac{\partial e}{\partial N} = \frac{R(e)}{NR'(e)} > 0. \tag{A4}$$

Differentiate the gains from implicit contracting $(1-\alpha)R(e)$ with respect to N to obtain

$$(1-\alpha)R'(e)\frac{\partial e}{\partial N} > 0.$$

Note that the gains from implicit contracting are linear in N as the second derivative of $(1-\alpha)R(e)$ with respect to N is

$$\begin{aligned}\frac{\partial}{\partial N}\left((1-\alpha)R'(e)\frac{\partial e}{\partial N}\right) &= \frac{\partial}{\partial N}\left(\frac{(1-\alpha)R(e)}{N}\right)\\ &= -\frac{(1-\alpha)R(e)}{N^2} + \frac{(1-\alpha)R'(e)}{N}\frac{\partial e}{\partial N}\\ &= -\frac{(1-\alpha)R(e)}{N^2} + \frac{(1-\alpha)R(e)}{N^2} = 0\end{aligned}$$

where first and third equalities are obtained by substituting the expression for $\partial e/\partial N$ obtained in Equation (A4).

$e \geq e^1$ as e^1 precludes breach even in the case of a single shareholder. $e \leq e^{max}$ as e^{max} is the effort that would be exerted by the employee in the absence of any possibility of breach. Q.E.D.

Proof of Proposition 4: The problem solved by investors in a leveraged buyout following the choice of effort by the employee is

$$\underset{\substack{N \\ 1 \leq N \leq N^{max}}}{\text{Max}} \quad (1 - \beta(M))\underline{R} - Nmc + (1 - \alpha(B))R(e) - Nbk.$$

Note the contrast with problem (5), as the prior choice of effort by the employee transforms the implicit contracting problem into one that is similar to the monitoring problem. Single ownership maximizes the gains from monitoring, as was established in Proposition 1. Single ownership also maximizes the gains from breaching existing implicit contracts, as $(1 - \alpha(B))R(e) - Nbk$ was shown in Lemma 4 to be decreasing in N. Q.E.D.

Proof of Proposition 5: The proof is immediate from the observation that the ability of investors to alter over time the level of diffusion of ownership transforms the two-period problem into two independent single period problems. Proposition 4 then implies that single ownership will be chosen in both periods. Any reversion at time $t = 1$ to more diffuse ownership that is intended to elicit from the employee a level of effort greater than e^1 fails to do so, for the employee foresees the choice of single ownership in the second period. There is therefore no reversion to more diffuse ownership at time $t = 1$. Q.E.D.

Proof of Proposition 6: As in the case of Proposition 5, the ability of investors to alter over time the level of diffusion of ownership transforms the two-period problem into two independent single period problems. Unlike the case of Proposition 5, however, a reversal to more diffuse ownership at time $t = 1$ does serve to elicit a level of effort greater than e^1 from the employee, because the costs of a leveraged buyout preclude any change in the concentration of ownership in the second period (see the first inequality in assumption (7)). The employee is thus willing to exert the level of effort corresponding to the level of diffusion of ownership chosen at time $t = 1$, which is N^* by Proposition 3. The costs of a leveraged buyout are not, however, so high as to preclude a change in the concentration of ownership in the first period (see the second inequality in assumption (7)), in which single ownership is chosen by Proposition 4. Q.E.D.

Proof of Proposition 7: We shall show that expression (8) is smaller than expression (9) in the case where all firm value can be attributed to implicit contracts, and $\underline{R} = 0$.

To see this, note that problems (5) and (10) now become

$$\underset{1\leq N\leq N^{\max}}{\text{Max}}_{N} \quad (1-\alpha)R(e) \tag{5'}$$

and

$$\underset{1\leq N\leq N^{\max}}{\text{Max}}_{N} \quad (1-\alpha(B))R(e^2) - Nbk + \delta(1-\alpha)R(e) \tag{10'}$$

respectively. The solution to problem (5') is $N^* = N^{\max}$ by Lemma 3. Problem (10') has first-order condition

$$-\alpha'(B)R(e^2)\frac{\partial B}{\partial N} - bk - Nk\frac{\partial b}{\partial N} + \delta(1-\alpha)R'(e)\frac{\partial e}{\partial N} + \lambda - \mu = 0 \tag{11'}$$

where λ and μ denote the Lagrange multipliers associated with the constraints $N \geq 1$ and $N \leq N^{\max}$ respectively. The employee does, however, foresee breach. He therefore chooses e^2 so as to preclude it. Equation (11') thus becomes

$$\delta(1-\alpha)R'(e)\frac{\partial e}{\partial N} + \lambda - \mu = 0 \tag{11''}$$

which has the solution $N^2 = N^{\max}$, thus implying $e^2 = e^{\max}$. Expressions (8) and (9) then become

$$(1-\alpha)R(e^1) + \delta(1-\alpha)R(e^{\max}) - c_l \tag{8'}$$

and

$$(1-\alpha)R(e^{\max}) + \delta(1-\alpha)R(e^{\max}) - c_l. \tag{9'}$$

The former is smaller than the latter. Q.E.D.

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